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Pigs gain at a somewhat faster rate when diets are supplemented with copper at a level of 250 parts per million (ppm). Other minerals appear to interact with copper in the metabolism of the pig. It has been observed that zinc supplied in the diet with copper decreased the amount of copper stored in the liver. One of the objectives of this study was to obtain further information on the value of copper in swine diets and to determine the effect of a high level of zinc on liver copper storage. Another objective of this experiment was to study the effect of supplemental vitamin E in swine diets. Although some experiment stations have reported vitamin E deficiencies in pigs, a previous report from this station (A.S. Series 70-32, 1970 Swine Field Day) did not indicate any value of supplemental vitamin E in diets for growing-finishing pigs.

Experimental Procedure

Sixty crossbred pigs averaging approximately 43 lb. were randomly allotted to two replications of six treatments on the basis of litter, weight and sex. Each lot consisted of five pigs, three barrows and two gilts. The pigs were housed in a building having concrete floors and automatic waterers in the pens. Self-feeders were located in connecting outside, concrete lots.

The six dietary treatments were as follows:

1. Basal diet.
2. Basal diet plus vitamin E, 10 I.U./lb.
3. Basal diet plus zinc, 500 ppm.
4. Basal diet plus copper, 250 ppm.
5. Basal diet plus vitamin E and copper at above levels.
6. Basal diet plus zinc and copper at above levels.

The composition of the basal diet is shown in table 1.

The pigs were removed from their respective treatments at individual weights of approximately 210 lb. The pigs were slaughtered about 24 hours later. Feed was withheld during this period, but they did have access to water. Blood and liver samples were obtained at the time of slaughter. After a 24-hour chill, carcasses were weighed and measured for length, backfat thickness, loin eye area and percent ham and loin.

Results

A summary of the growth performance and carcass data is presented in table 2. Pigs fed diets containing supplemental zinc, copper or both zinc and copper gained somewhat faster than those pigs fed the basal diet or this diet supplemented with vitamin E. However, there were no statistically significant differences in gains of pigs. Pigs fed the zinc and copper diets consumed slightly more feed daily. However, the feed/gain ratio was similar and did not differ between treatments.

The carcass data obtained showed some variation between treatments, but these differences were small. There were no significant differences in carcass length, backfat thickness, loin eye area or ham and loin percent.

A summary of the blood and liver data is presented in table 3. A reduction in the weight of livers from pigs fed zinc or copper was obtained. A similar decrease in liver weight was observed in the previous trial; however, the significance of this change is unknown. Liver copper storage was much higher when pigs had received the diets containing 250 ppm of copper. Some reduction in liver copper was noted when zinc or vitamin E was included in the high copper diets. Liver zinc did not appear to be markedly affected by supplemental zinc. Average liver zinc levels were quite high, approximately 250 to 350 ppm, and may be related to the level of 100 ppm of supplemental zinc in the basal diet. Plasma copper, plasma zinc, hemoglobin and hematocrit were not affected by dietary treatment.

Summary

Sixty crossbred pigs, 36 barrows and 24 gilts, were allotted to six treatment groups to study the effect of vitamin E, copper, zinc and combinations of these ingredients upon average daily gains, feed consumption and efficiency, carcass data and blood and liver characteristics.

Rates of gain for those pigs fed diets containing zinc and/or copper were higher but not significantly so. Supplementing the diet with 10 I.U. of vitamin E per lb. was of no benefit. Feed efficiency and carcass characteristics were not affected by the addition of any of these supplements. Plasma copper, plasma zinc, hemoglobin, hematocrit and liver zinc values were not affected by treatment. Storage of copper in the liver was increased when diets contained 250 ppm of copper and liver weights were reduced when pigs were fed either supplemental zinc or copper.

Table 1. Composition of Basal Diet

Ingredients	Percent
Ground yellow corn	82.80
Soybean meal	15.00
Ground limestone	0.75
Dicalcium phosphate	0.85
Salt	0.50
Trace mineral mix[a]	0.05
Vitamin mix[b]	0.05

[a] Provided 100 ppm zinc, 50 ppm iron, 27.5 ppm manganese, 5 ppm copper, 0.5 ppm cobalt and 0.75 ppm iodine.

[b] Provided 3,000,000 I.U. vitamin A, 300,000 I.U. vitamin D, 2.9 gm. riboflavin, 6.1 gm. pantothenic acid, 15 gm. niacin, 16.7 gm. choline and 16 mg. vitamin B_{12} per ton.

Table 2. Effect of Copper, Zinc and Vitamin E on Performance and Carcass Characteristics of Swine

	Basal	Vitamin E	Zinc	Copper	Copper + E	Copper + zinc
No. of pigs[a]	9	9	10	9	10	10
Avg. daily gain, lb.	1.61	1.54	1.67	1.70	1.67	1.70
Avg. feed consumed, lb.	5.35	5.32	5.54	5.66	5.76	5.73
Avg. feed/gain, lb.	3.52	3.43	3.35	3.35	3.45	3.45
Carcass data						
Avg. length, in.	29.8	29.6	30.0	29.5	29.7	29.5
Avg. backfat, in.	1.25	1.18	1.30	1.23	1.31	1.28
Avg. loin eye area, sq. in.	4.9	4.8	4.7	4.6	4.8	4.9
Avg. ham-loin, percent	41.8	41.3	40.5	41.8	40.8	41.3

[a] Two lots of 5 pigs per treatment, approximate initial weight, 43 lb., average final weight, 212 lb.

Table 3. Effect of Copper, Zinc and Vitamin E on Liver and Blood Characteristics

	Basal	Vitamin E	Zinc	Copper	Copper + E	Copper + zinc
Liver weight, lb.	3.19	3.05	2.88	2.73	2.78	2.88
Liver copper, ppm	16.96	15.46	16.33	161.54	105.50	102.25
Liver zinc, ppm	300.20	256.92	295.46	298.42	323.08	359.83
Plasma copper, ppm	2.02	1.99	2.03	2.14	2.30	2.25
Plasma zinc, ppm	1.18	1.11	1.34	1.10	1.40	1.32
Hematocrit, %	44.86	41.94	43.43	45.22	46.04	46.19
Hemoglobin, g./100 ml.	14.29	13.81	14.71	13.90	14.35	13.93